

SECTION 27 41 00

ARCHITECTURALLY INTEGRATED AUDIO-VIDEO SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Architectural, structural, mechanical, electrical, and other applicable documents and drawings are considered a part of the Audio-Video Systems and Equipment documents insofar as they apply as if referred to in full.

1.2 DESCRIPTION OF THE WORK

- A. This Section, together with the related drawings and General Conditions of the contract, comprise the requirements for the Audio-Video systems for this facility. The Audio-Video Systems (hereafter referred to as AV Systems) include but are not limited to the following areas in the Student Union. The Cochran Theater, associated back-of-house areas, Theater Control room and Lobby.
 - 1. Theater Sound Reinforcement Systems: Provide for microphone and line level inputs at designated locations in the Theater and associated spaces for pre-amplification, bussing and routing to the Audio Matrixing and Control System. Left, center and right loudspeakers, and subwoofers comprise the primary sound reinforcement loudspeaker systems. Additional surround loudspeakers, as well as cinema processing, will supplement the primary system when employed in a cinema configuration.
 - 2. Theater Audio Matrixing and Control System: This system allows for the distribution, processing and control of audio systems within the facility. This system is used for sound reinforcement system processing and routing as well as volume control and routing of program material throughout the facility.
 - 3. Theater Distributed Ceiling-Mounted Loudspeakers: These units will be mounted throughout the back of house areas as well as control room. Equipment make, model, and method of installation shall follow manufacturers' recommendations.
 - 4. Theater Production Intercom system at designated locations.
 - 5. Theater Video Projection, Audiovisual presentation and control systems: A DCI compliant video projector will be provided for digital cinema as well as standard video media presentations and recording. Sources will include desk-top PC, laptop PC, standard DVD, Blu-ray DVD, streaming device, and true digital cinema. A robotic camera and audio video digital recording system is also provided. The control system will provide comprehensive control of all video, audio and presentation elements. Touch screen control panels will be provided for the user interface to the audiovisual system.
 - 6. Portable systems and equipment, as designated.
 - 7. Add. Alternates as designated in this section and associated Audiovisual drawing package.

8. Ancillary devices related to the Sound Reinforcement systems including, but not limited to, mixing, processing, amplification, microphones, jacks, wire, and other miscellaneous parts of the system.
9. Lobby SMD LED video display wall and associated equipment. Provide all processors, sources, and supplemental equipment as shown.

1.3 SCOPE OF THE WORK

- A. These Specifications, together with the related drawings and General Conditions of the contract, comprise the requirements for the AV Systems for the project.
- B. Furnish, deliver, erect, install and connect completely all of the material and appliances described herein and in the Drawings, and supply all other incidental material and appliances, tools, transportation, etc., required to make the work complete, and to leave the AV Systems in first class operating condition, excluding those items listed under GENERAL, 1.10, RELATED WORK IN OTHER SECTIONS.
- C. Perform all assembly of equipment, wiring and inter-connection and soldering of wires to jacks, devices, terminals or equipment, using technical employees only, who are experienced in the installation of AV System equipment and its inter-connection. Coordinate final utility rough-in locations with actual equipment furnished.
- D. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturers' recommendations and all applicable code requirements.

1.4 QUALITY ASSURANCE

- A. The intent of this Section is to describe and provide for complete AV Systems of high professional quality and reliability. Professional performance standards by the AV Systems Contractor (hereafter referred to as Installer) and the equipment will be required.
- B. In all cases, the Owner and Architect/Engineer shall determine the acceptability of the work based upon the visits, observations, and reports of the AV Systems Consultant (hereafter referred to as Consultant).

1.5 INSTALLER QUALIFICATIONS

- A. The work performed under this Section shall be performed by an AV Systems contractor, normally engaged in the business of AV Systems installation. The prospective contractor shall show proof, as part of the bid that the contractor has been in the AV Systems installation business for a period of not less than five years and has successfully completed projects of similar size and scope.
- B. All work shall be performed by employees of the AV Systems subcontractor, and not by contract employees. Work crew(s) must be supervised by a technician holding a current CTS-I certification, or equivalent.
- C. Each bidder shall hold a current, valid franchise for the major lines of Audiovisual equipment furnished by him under these Specifications. When factory training and certification is required for a given product the contractor may be required to present written proof of certification.
- D. The Owner and Architect/Engineer reserve the right to reject any bids submitted by firms without sufficient experience in projects of similar size and scope.

1.6 SUBSTITUTIONS

- A. Refer to Division 01 for specific substitution procedures and submittal requirements.
- B. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- C. Requests for substitution, when forwarded by the Installer to the Consultant and Owner, are understood to mean that the Installer represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the Installer will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
- D. Substitutions will not be considered if they are indicated or implied in Shop Drawing submissions without previous formal request, or, for their implementation, they require a substantial revision of the Contract Documents in order to accommodate their use.
- E. Space allocations and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. The Installer shall coordinate final utility rough-in locations with actual equipment furnished.
- F. Where substitute equipment requiring different arrangement or connections from those shown in the drawings is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Pay all additional costs incurred by adjoining or connecting trades.
- G. All requests for substitutions shall be submitted five (5) business days before the bid opening date. Substitutions shall be requested and approved in writing only, based upon these criteria.

1.7 COOPERATION AND COORDINATION

- A. Cooperate and coordinate as required with the other contractors who are responsible for work not included in this section.
- B. Provide any and all information as required or requested by the Owner, Architect/Engineer, Consultant, or General Contractor in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Consultant.

1.8 GUARANTEE AND WARRANTY

- A. Guarantee all parts, labor, and workmanship furnished under this contract for a period of twelve months from the official date of acceptance.
- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 48 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- D. Furnish complete and working AV Systems. Be of maximum assistance to the Owner during the guarantee period of the system, to the degree that maximum Owner satisfaction is assured.
- E. After completion of the work, the Installer shall submit a Certificate of Warranty, stating commence and expiration dates and conditions of the warranty, for signature of both parties. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Installer.

1.9 SUBMITTALS

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Electronic files of drawings will be made available to the Installer from the Consultant free of charge upon the receipt of a signed electronic files disclaimer. The available drawings shall include only: (1) Legend/Power requirements, (2) Conduit Riser, (3) Floor and Reflected Ceiling Plans, (4) Section Views. Drawings shall be prepared and submitted in PDF format as directed by the Architect. Equipment lists, data sheets, etc. shall be 8-½" x 11" size, properly bound into a single or multiple volumes as necessary, or submitted in electronic PDF format. Submit quantity in accordance with Division 1, General Requirements.
- B. Within 45 days after the notice to proceed, submit to the Architect/Engineer identical copies of the following for approval:
 - 1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item;
 - 2. Manufacturers' data sheets on all equipment items;
 - 3. Equipment rack layouts showing locations of all rack mounted equipment items;
 - 4. Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8"=1'-0", showing loudspeaker locations and orientation, wall plates, and all other related device locations;
 - 5. Proposed construction details for any manufacturer-supplied, third party, and custom fabricated items, including interface panels, patch panels and patchbays, wall plates, speaker mounts and rigging details. These details shall show dimensions, materials, finishes and color selection;
 - 6. Comprehensive system schematics, showing detailed connections to all equipment, with wire numbers, terminal block numbers, and color coding;
 - 7. Riser diagrams showing conduit requirements with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit;
 - 8. Electrical power requirements for head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail to coordinate with the electrical contractor, showing exact conduit requirements and locations for switched duplex receptacles;
 - 9. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.
 - 10. Submission of the AV Systems Contract Documents / Bid Documents does not constitute a legitimate submittal and will not be accepted.

11. Incomplete submittals will not be reviewed. Complete Shop Drawings and Product Data shall be submitted as a singular submittal, with the only exceptions being devices required to be provided by the Installer to Division 26 for installation.
- C. All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Submit the following in accordance with Division 1, General Requirements. The Installer shall provide final documentation in electronic formats. Suitable electronic formats include Microsoft Word and Excel, AutoDesk (.dwg, .dwf), and adobe Acrobat (.pdf).
1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item;
 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codes. System performance measurements as noted elsewhere in this specification shall be documented. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.). Submit copies of all final uncompiled programming source code and software settings of each system and equipment items that are software controlled;
 3. Complete equipment rack layouts showing locations of all rack mounted equipment items;
 4. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties.
 5. Technical Systems Operations Manual, custom-written by the contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventative maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately;
 6. Incomplete submittals will not be reviewed.

1.10 RELATED WORK IN OTHER SECTIONS

- A. All conduits with pull strings, all electrical pull boxes, all cable trays, and all outlet boxes shall be furnished and installed under the electrical section of Division 26. Conduits shall be run continuously from outlet box to outlet box. Conduit stub-outs are not acceptable, except as noted. Coordinate as necessary for proper installation.
- B. All 120VAC power conductors and conduits associated with power circuits to all equipment locations shall be furnished and installed under the electrical section of Division 26. The 120VAC power to the equipment racks shall be terminated inside the racks to Electrical contractor-supplied isolated ground duplex receptacles.
- C. An insulated THW stranded copper ground wire, sized according to NEC, shall be installed under the electrical section of Division 26 from the equipment racks sheet metal to the primary ground point within the building, and terminated at each end to bare metal using approved connectors and clamps.
- D. All built-in millwork and any grille cloth shall be furnished under other sections, unless explicitly noted otherwise.
- E. Electrical circuits shown in the AV System drawings are for reference only in depicting the number of electrical circuits needed for operation of these systems.

- F. Broadband signal feeds.
- G. Satellite signal feeds and equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items shall be new and unused. The following articles specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity or better quality shall be furnished.
- B. Refer to Article 1.6, SUBSTITUTIONS of this Section.

2.2 WIRE AND CABLE

- A. All wire and cables shall be new and unused.
- B. Wire not installed in equipment racks, not portable, or not installed in conduit shall be plenum-rated and meet all applicable codes. Plenum rated cable can only be used, if at all, in locations specified in the associated Audiovisual drawings. The systems contained in the system package are designed around standard PVC jacketed cable and EMT.
- C. Any and all exposed exterior cabling shall be UV rated.
- D. Voice coil loudspeakers:
 - 1. High frequency devices: West Penn 226 14AWG twisted pair.
 - 2. Mid frequency devices and speaker monitor circuits: West Penn 227 12AWG twisted pair.
 - 3. Full Range devices: West Penn HA210 10AWG twisted pair.
 - 4. Low frequency devices: West Penn HA210 10AWG twisted pair.
- E. Constant voltage (70.7-volt) loudspeaker cable:
 - 1. Runs of less than 200 feet: West Penn 225 stranded 16AWG jacketed twisted pair.
 - 2. Runs of 200' to 300': West Penn 226 stranded 14AWG jacketed twisted pair.
 - 3. Runs of 300' to 500': West Penn 227 stranded 12AWG jacketed twisted pair.
 - 4. Runs of 500' or more: West Penn HA210 stranded 10AWG jacketed twisted pair.
- F. Microphone-level audio cable (installed in conduit, not portable): West Penn Wire 452 stranded 22AWG twisted pair with foil shield.
- G. Line-level audio cable and all inter-rack audio cable: West Penn Wire 452 stranded 22AWG jacketed twisted pair with foil shield.

- H. Production Intercom cable installed in conduit: West Penn 292 stranded 20AWG twisted pair with foil shield. Where two channels are needed at any station: West Penn D440 stranded 18AWG two twisted pair with individual foil shield.
- I. Wireless microphone and RF Assistive Listening System antenna cable: Belden 9310, 50 ohm RG-58A/U coaxial cable with appropriate 50-ohm connectors. For runs that exceed 50 feet, Belden 9914, 50 ohm RG-8A/U type coaxial cable with appropriate 50-ohm connectors shall be used.
- J. Installed Data cable: CAT6 UTP per project Structured Cabling specification or Owner standard.
- K. Data Patch cables: CAT6 UTP per project Structured Cabling specification or Owner standard.
- L. Crestron DigitalMedia 8G: DM-CBL-8G-NP non-plenum ultra high-bandwidth shielded twisted pair.
- M. Multipin Audio Snake Cables:
 - 1. Whirlwind MASS W4, or approved equal corresponding to chassis multipin connectors supplied, custom configured for connectivity shown in the associated contract documents.
 - 2. Whirlwind MicroMASS W6, or approved equal corresponding to chassis multipin connectors supplied, custom configured for connectivity shown in the associated contract documents.
- N. Fiber Optic Cable:
 - 1. Installed: Riser rated 2-strand multimode, either pre-terminated or fusion-spliced to factory pigtails. Cable characteristics and connectors shall be compatible with network electronics and plate-mounted connectors supplied.
 - 2. Portable/patch: 2-strand multimode, pre-terminated. Cable characteristics and connectors shall be compatible with network electronics and plate-mounted connectors supplied.
- O. Other equipment control cables shall be stranded wire, appropriately shielded, of gauge and number of conductors required by the manufacturer for proper operation of the system or equipment item furnished.
- P. Wire and cable for all other devices shall be supplied in accordance with the recommendations of the device manufacturer and the National Electrical Code.

2.3 JACKS, CONNECTORS, AND WALL PLATES

- A. All plate-mounted connectors shall be ground-insulated from the plates on which they are mounted.
- B. Floor-mounted jacks, unless noted otherwise, shall be installed in floor pockets (described in this section). The interior plates shall be painted or anodized black. Nomenclature shall be engraved into the interior plate of each floor box with 1/8" block letters filled with white paint.
- C. For non-standard custom panels, connectors shall be installed on 1/8" thick brushed stainless steel panels. Nomenclature shall be engraved into the plate with 1/8" block letters filled with black paint.
- D. All other jacks shall be installed on standard brushed stainless steel finish plates. Nomenclature shall be engraved into the plate with 1/8" block letters filled with black paint. All microphone locations shall be numbered logically and consecutively, starting from one (1).
- E. Unless otherwise specified, all jacks and connectors for the sound systems shall be as follows:

1. Microphone and line-level input jacks (XLR type): Neutrik NC3FD-L-1-B 3-pin female XLR panel-mount jacks with gold-plated contacts.
2. Line-level input jacks (Combination XLR/TRS type): Neutrik NCJ6FI-S XLR/TRS hybrid connector; parallel associated pins for single output regardless of connector type inserted.
3. Audio output jacks (XLR type): Neutrik NC3MD-L-1-B 3-pin male XLR panel-mount jacks with gold-plated contacts.
4. Female cable-end audio connectors: Neutrik NC3FX-B 3-pin female XLR connectors with gold-plated contacts.
5. Male cable-end audio connectors: Neutrik NC3MX-B 3-pin male XLR connectors with gold-plated contacts.
6. Video Tie Line jacks: Neutrik NBB75FI BNC bulkhead jack.
7. Wireless Microphone and Assistive Listening Antenna jacks: 50-ohm chassis-mount feed-through jack, specific to cable supplied.
8. Digital Audio Network jacks: Neutrik NE8FDY-C6-B CAT6 panel connector with black housing, or approved equal.
9. Chassis mounted speaker connectors:
 - a. 4-pole locking jack: Neutrik NL4MP or approved equal.
 - b. 8-pole locking jack: Neutrik NL8MPR-BAG or approved equal.
10. Cable mounted speaker connectors:
 - a. 4-pole cable connector: Neutrik NL4FC or approved equal.
 - b. 8-pole cable connector: Neutrik NL8FC or approved equal.
11. Chassis mounted production intercom connectors:
 - a. Neutrik NC6MSD-L-1, or approved equal 6-pin XLR male with Switchcraft pin configuration.
 - b. Neutrik NC6FSD-L-1, or approved equal 6-pin XLR female with Switchcraft pin configuration.
12. Chassis mounted multipin audio connectors:
 - a. Whirlwind MASS W4CRP, or approved equal, 176 pin chassis connector with crimp type pin/socket. Provide Whirlwind W3W4AK MASS Angle Adaptor for each unit supplied.
 - b. Whirlwind MicroMASS W6CRP, or approved equal, 84 pin chassis connector with crimp type pin/socket. Provide Whirlwind W5W6AK MicroMASS Angle Adaptor for each unit supplied.
13. Chassis mounted fiber optic connectors: Whirlwind EHLC2M or approved equal duplex LC feed-through connector.
14. Multipin AV / Data connectors. Provide the following or approved equal containing required quantity of contacts and data connections within a single multipin connector:

- a. BTX ProBlox-D receptacle for chassis-mounted locations. Provide crimp contacts, crimp tool and insertion and extraction tools, as required.
- b. BTX ProBlox-D plug with hood/shell for cable-mounted locations. Provide crimp contacts, crimp tool and insertion and extraction tools, as required.

F. Furnish and install the required number of jacks and connectors as shown on the drawings.

2.4 EQUIPMENT CABINETS AND POWER DISTRIBUTION

- A. Furnish equipment cabinets for use in housing equipment including, but not limited to, power amplifiers, signal processors, microphone splitters, playback equipment, intercom equipment, etc. Provide a ¼" (nominal) non-conductive industrial-grade black rubber mat under each cabinet trimmed to the footprint of the cabinet for isolation from building structure.
- B. Equipment cabinet colors shall be satin black.
- C. Each equipment cabinet shall include locking front and rear doors, and top and bottom panels, ventilation fan, thermostat control, and work light unless otherwise noted. Provide one pair of side panels for each cabinet array.
- D. Heat-producing components – such as power amplifiers – shall be mounted with one 1-3/4" vent panel installed between units or as the manufacture recommends. Fill all other portions of unused cabinet front sections with matching blank panels.
- E. Install the required number of units, of sufficient size to accommodate the equipment specified, at the locations indicated in the drawings.
- F. Furnish 5 keys for each type of equipment console lock installed.
- G. All mounting screws shall be theft resistant.
- H. Furnish and install the following:
 - 1. Floor Mounted Equipment Cabinets: Middle Atlantic Products ERK-44-20 stand alone rack, or approved equal, to include rear doors, side panels, rear rack rails, and QBP-2A fan for each cabinet as required. Provide all accessories as required for proper installation and support of all devices at each location. Provide (1) Middle Atlantic WL-60 worklight for each unit supplied. (Qty: as shown) Provide Middle Atlantic RM-KB pull-out keyboard for each computer.
 - 2. Rack Drawers: Middle Atlantic D3-LK 3RU rack drawer with lock, or approved equal. (Qty: as shown)
 - 3. Power Sequencer: Middle Atlantic PDT-2X320 vertical power strip for each dedicated circuit and Furman CN-1800S power sequencers. All processor to be on un-switched outlets including PC's, DSP's, control processors, audio processors, etc. Provide all raceway connection and mounting accessories for proper termination by Div. 26. Configure as required for each cabinet, per power circuits shown in AV power drawing. (Qty: as shown)
 - 4. UPS: Middle Atlantic UPS-S100R 1000VA Uninterruptible Power Supply for unswitched equipment, or approved equal. (Qty: as shown)

2.5 AUDIO DIGITAL SIGNAL PROCESSING

- A. The audio processing shall be in the digital domain following the input source and shall remain until power amplification is required.
- B. The Digital Audio Platform shall be available in various I/O configurations. Inputs/outputs shall be specified in pairs, up to a total of 24 mic/line Inputs.
- C. Electronically balanced inputs and outputs shall be provided on plug-in barrier-strip connectors. Inputs and outputs shall be individually programmable for either microphone or line level signal. Provide expansion units as required for adding analog or digital inputs/outputs to a system.
- D. Software shall be provided for creating/connecting DSP system components within each hardware unit. Available system components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, and diagnostics.
- E. Ethernet communications shall be utilized for software control, configuration, and DSP distribution. Each hardware configuration shall be available with CobraNet. CobraNet technology shall transport digital audio over fast Ethernet, allowing multiple units to share digital audio. Multi-unit applications shall require an external 10/100/1000 Base-T Ethernet switch. All CobraNet and Ethernet connections shall be via CAT6 cable.
- F. After initial programming, systems may be controlled using either TCP/IP or RS-232 serial communication by third party control systems (such as AMX® and Crestron®), by PC computer, and/or by dedicated remote control devices. Software shall operate on the rack mounted PC computer, with network card installed, running the latest Windows® operating system.
- G. Furnish and install the following, mount as indicated in the drawings. These devices are associated with the Theatre and auxiliary spaces, as shown:
 - 1. Digital Signal Processor: Biamp Teira Server-IO.
 - 2. Digital Signal Processor: Biamp SIC-4 4-channel mic/line input cards.
 - 3. Digital Signal Processor: Biamp SOC-4 4-channel mic/line output cards.
 - 4. Digital Signal Processor: Biamp Tesira EX-IN Expander Input Box.
 - 5. Digital Signal Processor: Biamp Tesira EX-OUT Expander Output Box
 - 6. Ethernet Switch: Cisco WS-C3750X-48P 48-port 10/100/1000 Mbps Power-over-Ethernet switch, or approved equal. To include power supply, rackmount kit, and all accessories required for proper and intended operation. Provide all cabling to satisfy the associated schematic one-line drawings.
- H. Furnish and install the following, mount and connect as indicated in the drawings. This device is associated with the Cinema Surround Sound processing:
 - 1. Dolby CP750 cinema audio / surround sound processor with all required components and accessories, or approved equal for interfacing with DCI Cinema projector supplied and complying with intent of the contract documents.
- I. Successful Contractor shall be responsible for programming the software configuration file for each system based on intended functionality shown in the drawings. "User" control screens shall be provided

which allows limited control by the end user and without access to system schematics. Contractor shall provide a review copy of each file to the Consultant for review at the latest four (4) weeks prior to schedule commissioning trip.

2.6 LOUDSPEAKERS

- A. The drawings indicate the loudspeaker positions and aiming points for each loudspeaker.
- B. Speakers shall be mounted to the structure, at the positions and angles indicated relative to the aiming points. Suspend each component with commercial rigging hardware, in such a way as to facilitate minor angle adjustments. Safety factor shall be at least 5. Furnish rigging details during submittal process. Secure any loose hardware to prevent vibration and rattling. Orient each speaker at the location and angles indicated in the drawings. Make minor adjustments as required to provide even sound distribution.
- C. Measure and record the impedance of each driver at the amplifier terminals. High frequency drivers shall be measured at 1000Hz; low frequency drivers shall be measured at 250Hz. Include the measurements in the final documentation.
- D. For loudspeakers incorporating 70.7v transformers/autoformers, tap as indicated in the drawings.
- E. Retain the services of a registered professional structural engineer licensed to practice in the state of project installation to develop mounting details, including attachment to the building structure. Structural information shall include design calculations and a copy of engineer's certification.
- F. Verify factory loudspeaker color option selection with Architect prior to product acquisition.
- G. Furnish and install the following assemblies:
 - 1. Left, and right channel main speakers to have 50 degree x 100 degree asymmetrical rotatable horn and shall provide 96dB SPL at 1W at 1 meter. Shall have a peak SPL of 125dB SPL for 200~500 watts RMS. To have a 1x8" low frequency drivers and a 1x1" neodymium high frequency driver on a low distortion asymmetrical horn. To have a frequency response of 69Hz -19KHz. Shall have Neutrik connections. Units to be Yamaha Nexo PS8, or approved equal loud speaker. Hang speakers with VNI-UBRK8 brackets or other approved mounting system.
 - 2. Center channel speaker to have 50 x 100 degree asymmetrical rotatable horn and shall provide 99dB SPL 1w at 1 meter. To have 10" low frequency neodymium driver and 1x1" neodymium high frequency driver on a low distortion horn. Shall have Neutrik connections. Unit to be Yamaha Nexo PS10U-R2 loud speaker, or approved equal. Hang speaker using VNI-LBRK mounting hardware or other approved mounting system.
 - 3. Sub Woofers to have dual 15" drivers, 30Hz – 400Hz frequency response and have a SPL of 139 dB. Units to be Electrovoice XLCi-215-FG sub woofer, or approved equal. Utilize approved mounting system from Polar Focus or other approved manufacturer.
 - 4. Surround speakers to be JBL 8340A High Power Cinema Surround loudspeaker with 10-inch LF transducer and 100x80 horn. Provide (1) JBL Quickmount mounting bracket, or approved equal, for each unit supplied.
 - 5. Back of house ceiling speakers to be Electrovoice EVID C8.2LP 70 volt flush mounted ceiling speakers, or approved equal. Qty. as required.

2.7 POWER AMPLIFIERS

- A. Each power amplifier shall have an input connector which is either screw-type barrier strip, phoenix-type, or XLR-type. Output connections shall be barrier strip. Other types of connectors shall not be accepted.
- B. All power amplifiers shall have stepping input level controls. Install the units in the equipment racks, and connect as indicated in the drawings.
- C. Controller amplifiers to be installed and terminated according to manufacturers recommendations.
- D. Provide (1) one amplifier channel for each loudspeaker home run. Size amplifier based on total power consumption of each home run. Locate amplifier sound equipment cabinets associated with each loudspeaker home run / zone.
- E. Furnish and install the following, or approved equals:
 - 1. 1-channel amplifier, 40 watts @ 70 volts: Extron MPA 401, Back of House.
 - 2. 2-channel amplifier, 15 watts @ 4 ohms: Extron MPA 152 Plus, Back of House
 - 3. 4-channel controller amplifier, 600 watts @ 8-ohms: Nexo NXAMP4x1, Left, Center Right Mains.
 - 4. 2-channel amplifier, 1250 watts @ 8-ohms: Crown MA-5000i, Sub-Woofers.
 - 5. 8-channel amplifier, 600 watts @ 8-ohms: Crown DCi8-600, Surround Speakers.
 - 6. 2-channel amplifier, 100 watts @ 8 ohms: Extron XPA 1002 Plus, Stage Monitors.

2.8 VOLUME CONTROLS

- A. Furnish wall-mounted volume controls for use with the local control of distributed speaker systems at locations indicated. Size volume control for load at each space.
 - 1. Atlas Sound AT-** series volume controls, or approved equal.

2.9 AUDIO MIXING CONSOLE

- A. The Front of House digital mixing shall provide for mixing and routing stage and ancillary input sources to the DSP and sound reinforcement systems.
- B. The mixer shall be a digital mixing console designed for professional front-of-house, monitor, recording or multi-function mixing applications. The mixing console system shall provide a minimum of 48 mono input channels, 4 stereo line input channels, and 24 mono output channels.
- C. Shall have a network connection, digital snake port, and USB port. The mixing surface shall be capable of on-board digital signal processing for input and output channels. The surface shall have a built-in touch screen display for console functions. Shall have 10 mix outputs, 4 group outputs and 4 matrix outputs.
- D. Install the following digital mixing console in the locations as shown:
 - 1. Allen & Heath Qu-24 Audio Digital Mixing Console with configured Qu-Pad app for wireless control, or approved equal.
 - 2. Provide Shure SRH940 reference headphones, or approved equal.

2.10 PLAYBACK INPUT DEVICES

- A. Furnish a consumer audio playback input device for use in distribution throughout the sound reinforcement systems. Connect as indicated on the drawings. To provide balanced stereo outputs via stereo 3.5 mm mini-jack.
- B. Furnish and install the following at locations shown in the drawings:
 - 1. RDL DB-CIJ3D consumer input plate mounted audio device interface, or approved equal. (Qty: as shown)

2.11 ASSISTIVE LISTENING SYSTEM

- A. Furnish and install FM wireless assistive listening systems for use by the hearing-impaired. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile. The ALS system shall have 80dB SNR or greater, end-to-end. Receivers shall be frequency agile and frequency set with a "seek" button. The receiver will incorporate a stereo headset jack that allows the user to plug in either a mono or stereo headset and listen to audio normally. The portable receivers shall incorporate automatic battery charging circuitry for recharging of Ni-MH batteries.
- B. Furnish and install the following:
 - 1. Listen Technologies LS-04-216 Advanced Installed FM System, to include (1) transmitter with rackmount kit, (4) receivers with earbuds, antenna with remote mounting kit, charging/carrying case, rechargeable batteries, and ALS notification signage kit. (Qty: 1 complete system)
 - 2. Listen Technologies LA-166 Induction Neckloop. (Qty: 4 ea.)

2.12 PRODUCTION INTERCOM SYSTEMS

- A. Provide and install a wireless 2-channel intercom system in the locations as shown. System to be UHF based. To be supplied with base station, wall mount speaker stations and wireless belt packs and headphones. Install the intercom system in the configuration and locations as shown.
- B. Units to have 470-686MHz operating frequencies with presets in 25MHz increments. Provide wall mounted remote antenna. Provide all power supplies as required for a complete working system.
 - 1. Intercom base station to be Clearcom WBS-680 with rack mount. Beltpacks to be Clearcomm WTR-680 2-channel wireless beltpacks with CC-26K headsets, or approved equal. Supply a WTR4C recharger.
 - 2. Wall mount speaker stations to be Clearcom KB-702 2-channel speaker stations in the locations and quantities as shown, or approved equal.

2.13 WIRELESS MICROPHONE SYSTEMS

- A. Diversity UHF wireless microphone systems shall be used in all systems.
- B. Operating frequencies shall be as high as possible and selected so as to avoid interference. Consult with the manufacturer for frequency coordination.
- C. The wireless receivers shall be provided with rack-mount kits.
- D. Receivers shall employ Dante digital audio networking, in addition to analog outputs. Connect as indicated in the drawings.

- E. Furnish and install the following wireless system and accessories at the control room racks, or approved equal:
1. Shure UR4D+ Dual channel receivers with power supply and rack mount hardware.
 2. Shure UR2/SM58 Handheld transmitter with SM58 capsule.
 3. Shure UR1M bodypack transmitter.
 4. Shure / Countryman WCE6 omni-directional earset microphone for use with beltpack receivers. Verify color selection prior to product acquisition.
 5. Shure UA830 in line amplifiers.
 6. Shure UA860-SWB-XXX half wave omni directional antennas.
 7. Shure SB900-8 8-pack lithium-ion rechargeable batteries with SBC800-US 8-bay charging station.

2.14 MICROPHONES

- A. Provide the following wired mics and associated stands.
- B. Desk-top units to be 18" gooseneck microphones with cardioid pattern, mute switch, a frequency response of 40 Hz – 20,000 Hz and table-top base. Provide in the numbers as shown.
1. Units to be Shure MX418D gooseneck microphone package or approved equal.
 2. Hand-held wired microphones to have 50 – 15,000 Hz frequency response and shall be dynamic. Units to be Shure SM58 dynamic microphones, or approved equal. Each mic to be supplied with a Atlas Sound MS20 microphone stand, or approved equal.

2.15 DCI COMPLIANT CINEMA PROJECTOR SYSTEM AND SUPPORT EQUIPMENT

- A. Provide and install a DCI compliant video projector in the location indicated. Projector to be provided with lens, storage device, alternative content device, pedestal and shall be provided with all equipment as required for a complete and fully functioning cinema and alternative content system. Contractor to be manufacturer certified in cinema installation practices and cinema based products.
- B. Projector to have 1.2" 2k 3-chip DC2K dark metal devices, 24,500 lumens of brightness, and a native resolution of 2048 x 1080. To be provided with integrated cinema processor (ICMP), integrated storage of 1.9TB (RAID-5) and (3) three 1TB hot swappable 2.5" hard drives. Unit to be connected to active exhaust ducted cooling system provided by others with a minimum of 350 CFM..
- C. Integrated cinema processor to have (2) two display port inputs, (2) two 3G-SDI inputs, (1) one HDMI 1.4a input and AES/EBU audio outputs.
- D. Projection system to be provided with Barco CineMate App in iOS and Android operating systems, touch screen control panel, Barco commander & communicator software and projector mounting pedestal, and CineCare web. Cinema projector system to be installed, calibrated and commissioned by a Barco certified specialist or expert.
- E. Furnish and install the following DCI compliant video projector, or approved equal:
1. Barco DP2K-23B DLP Alchemy cinema projector system or other approved equal complete cinema system. Provide with all of the above listed accessories and peripherals. To be supplied

with DC2K 2.15-3.6 lens. Photometrics to be field verified. To be supplied with Ohram 4000W lamp with (1) one spare lamp provided.

2. Provide and install a Kramer FC-46xl HDMI audio de-embedder with S/PDIF, TOSLINK and analog audio outputs, or approved equal 7.1 Dolby surround sound HDMI de-embedder.

2.16 AUDIO VISUAL REMOTE CONTROL SYSTEMS

- A. These system components and associated programming shall be used for comprehensive control of the video and control equipment in the areas as shown. Final control panel layouts (GUI's) to be approved by the owner and consultant and shall be part of the video and control submittal process.
- B. Control panel Graphical User Interfaces shall at a minimum consist of the following sub-sections or pages. Pages constructed shall include detailed audio system control including individual mic muting and gain control.
- C. Video control includes image previewing and individual source routing to all displays from all sources as shown in the drawings. Transport control of all sources including all tuners and playback decks as shown. Interface to all external environmental elements such as a preset lighting system, shades and drapes if present should also be included.
- D. All GUI's shall be submitted to the consultant for approval prior to programming and finalization.
- E. **All associated un-compiled programming source code for the control systems shall be delivered to the owner for system backup and future modification purposes. This code is the property of the owner and will be utilized for the systems as indicated herein.**
- F. **All campus network connections to be coordinated with the campus network representatives. The campus IT department to set-up static IP addresses in association with the video and control contractor if applicable.**
- G. Furnish and install the following or approved equal:
 1. Provide, program and install a Crestron AV3 control processor with rack mount kit and all cards and peripherals as required for a complete control system or approved equal. (Qty. as required) Provide with Ethernet interface and C3COM-3 control port cards as required.
 2. Provide, program and install Crestron iPad and iPhone apps for (4) four owner provided devices. Contractor to download apps, program and configure owner provided devices.
 3. Provide, install, configure and program a XPanel GUI interface on the rack mounted PC.
 4. Wireless access points to be installed in the Theater. Units to be Crestron CEN-WAP-1500 high power Dual band wireless access point, or approved equal.
 5. LCD touch screen control panels to be Crestron TSW-1060-B-S 10.1" and TSW-760-B-S 7" HD touch screen control panel in the locations as shown or approved equal. Provide TSW-1060-TTK-B-S and TSW-760-TTK-B-S table top kits at the lectern and control room. Provide TSW-UMB-60 pre-construction mounting kit at stage wall mount location. Contractor to submit control panel GUI pages prior to programming and installation as part of the submittal process.
 6. Provide an ETC RS232 serial interface for control interface to the Theater lighting control system, verify control interface location.
 7. Provide and install Gefen or Extron RS-232 to twisted pair extenders for cable lengths over 50'-0" (fifty feet). (Qty. as required)

SYSTEM PROGRAMMING TO BE PERFORMED BY A CERTIFIED CRESTRON PROGRAMMER.

2.17 DIGITAL MEDIA SWITCHER

- A. Provide and install a digital media switcher in the configuration as shown and terminate as indicated.
- B. Units to have twisted pair, HDMI, DVI, HD-SDI and RGB inputs and twisted pair, HDMI and DVI outputs in the configuration as shown in the drawings, be HDCP compliant, have EDID minder and isolated inputs and outputs, Ethernet controllable, individually controlled inputs and outputs, automatic equalization and re-clocking and have an internal power supply.
 - 1. Unit to be Crestron DM-MD series DigitalMedia matrix switcher, or approved equal with Crestron certified DM-CBL-ULTRA-P-SP1000 plenum cable in air return plenums and CBL-ULTRA-NP-SP1000 non-plenum, shielded DM-8G-CONN RJ45 connectors (both cable and plate mounted), all plates, cards and extenders as shown or approved equal. (Qty. as shown) Observe minimum cable length requirements for DM products. AV contractor is responsible for ensuring Crestron quote includes all equipment as shown in drawings.
 - 2. Provide all output and input cards as shown. Provide all transmitters and receivers as indicated.
 - 3. **DM SYSTEM CONFIGURATION TO BE PERFORMED BY A CRESTRON DIGITAL MEDIA CERTIFIED ENGINEER.**

2.18 FLAT PANEL VIDEO DISPLAYS

- A. Provide and install the following flat panel monitors in the locations as shown and terminate as indicated.
- B. LED LCD monitor to have 1200 x 1080 resolution 1,000:1 contrast ratio, VGA input, HDMI input, anti-reflection viewing, and speakers.
 - 1. Flat panel video display units at the lectern and control room to be Viewsonic VG2453-LED LCD monitors or approved equal.

2.19 HD VIDEO CAMERAS, CAMERA CONTROLLER / LIVE SWITCHER SYSTEM

- A. Provide and install the following camera, remote camera controller, and live switcher in the locations as shown and terminate as indicated.
- B. All cameras to be PTZ units and have full HD CMOS 1/2.8 type and switchable 1920 x 1080i, 1080p resolution, 12x optical zoom lens, 67 degree wide and 6.6 tele angles of view, have pan/tilt/zoom capabilities and be RS-232 and local network PoE powered. Provide each camera with a wall mounting bracket, paint to match wall.
 - 1. Wall mounted PTZ units to be Vaddio RoboShot 12 HD-SDI pan/tilt/zoom color video camera or approved equal. (Qty. as required) All wall mounted PTZ cameras to be provided with Vaddio thin profile wall mount bracket painted to match wall surface. Provide power via PoE Ethernet switch. Mounts to be painted to match wall finishes, verify color with architect.
 - 2. Remote camera controller and live switcher to have HD-SDI inputs and outputs. Shall have HDMI and program outputs and DVI input. To provide camera switching and PTZ camera control. Unit to be Vaddio ProductionView HD-SDI MV production switcher camera controller or approved equal.
 - 3. Unit to be provided with Vaddio TeleTouch 22" touch screen controller monitor with multi-view control panel layout and expanded I/O capabilities, or approved equal multi-window touch screen controller.
 - 4. Provide and install a Sync generator to provide a reference signal to all equipment as shown. Unit to have (6) six analog black burst and tri-level sync signal outputs on BNC connectors. Units

to be Black Magic Mini series sync generator, or approved equal. Provide power supplies as required.

2.20 MEDIA COMPUTER AND MONITOR

- A. Provide and install the following computer in the locations as shown and terminate as indicated.
- B. Provide and install the following computer in the locations as shown and terminate as indicated. Unit to have Intel i5-6500 dual core processor, Memory to be 4GB, Hard Drive to have 500 GB SATA. To have Windows 7 professional O.S, and 64-bit operating system. Unit to have Dell MS111 USB optical mouse. Unit to have a 8x DVD Drive with Roxio creater Starter and Cyberlink Power DVD 9.5.1. Shall have a Nvidia Quadro K620 graphics card. Provide compact keyboard, verify it will fit in the pull-out keyboard shelf.
 - 1. Unit to be Dell Optiplex 7000 Series (7040 SFF) small form factor computer, or approved equal.
 - 2. Provide Middle Atlantic RM-KB-LCD17HD rack mounted video monitor and keyboard drawer or approved equal. Provide all DP to HDMI adaptors as required.
 - 3. Provide an Extron HDMI DA series HDMI distribution amplifier for each computer set-up, or approved equal.
 - 4. Provide and configure a Extron USB Extender Plus pair for the owner provided wireless keyboard and wi-fi dongle, or approved equal USB extender.

2.23 MEETING RECORDING CAPTURING AND STREAMING SYSTEM

- A. Furnish and install the following meeting recording system and terminate at the locations as shown. Unit to have recording inputs for a cameras and media content. Unit to provide recording, scheduling and content delivery. Units to have HDMI, VGA and 3G-SDI inputs. Unit to provide multiple scaling and output resolutions. Shall have 80GB SSD and rack mount.
- B. Contractor to provide integration and coordination with owner provided server for content access and distribution.
- C. Furnish and install the following at locations shown in the drawings:
 - 1. Extron SMP 351 3G-SDI HD capture system, or approved equal.

2.25 WIRELESS MEDIA SHARING SYSTEM

- A. Furnish and install the following wireless media sharing system and terminate at the locations as shown. Unit to be compatible with Windows, OS X, Apple iOS and Android operating systems. Unit to have HDMI and VGA outputs, full 1080p display resolution and shall support up to 32 users simultaneously. Contractor to provide integration and coordination with owner provided devices. To be rack mounted.
- B. Furnish and install the following at locations shown in the drawings:
 - 1. Crestron AM-100 Airmedia presentation gateway, or approved equal.

2.26 SURFACE MOUNTED SMD LED WALL DISPLAY

- A. Contractor to provide, commission, and install a surface mounted diode display wall in the configuration as shown. Display wall to be comprised of individual surface mounted diode modules manufactured for indoor use. Each cabinet segment comprising the LED display wall system to be secured together according to the manufacturers recommendations. Refer to audiovisual drawings for location, size and quantity. Verify location with architect. Wall to be secured to the front wall of the Student Union Lobby as shown.
- B. LED wall to be mounted with manufacturer provided and designed frame manufactured by USAbsen. Provide all hardware as required for a turn-key solution. Frame to be mounted at the locations as

shown. Provide all hoisting and lifting equipment as required for a complete and functional system. Unit to be convection cooled with no fans required.

- C. USAbsen to provide a certified representative to commission the video wall display to insure proper installation, mounting, set-up and calibration. Representative to provide written certification once installation and commissioning is completed.
1. The surface mounted LED wall to have a pitch of not more than 4.0 mm and shall produce a maximum of 1100 (cd/m²) of brightness and a horizontal viewing angle of 160 degrees. Display panels shall have a pixel density of 1152 x 596 diodes and shall be comprised of (4) four modules that are 288 x 288 mm. Modules to be USAbsen N4 Black SMD permanent display wall. Shall have 16 bit color grayscale and a refresh frequency of 1920 Hz. Approximate weight to be 650 lbs. Wall system to include sending card box, power supplies, installation pole, receiving cards, Nova Star software and module masks. Wall segments to attach together with a clamping mechanism that is secure and rigid. Shall run off a working voltage of 100-240 VAC.
 2. Video wall system to have a minimum warranty of five (1) year from the date of commissioning for all hardware. Wall to be provided with redundant equipment as stated below. This will include external sending cards, receiving cards panels and power supplies, Contact USAbsen for a quote, attention: Eric Lardner eric.lardner@usabsen.com 407-902-8160.
 3. Provide the following spare equipment to the owner upon the completion of system commissioning and calibration. (1) one external sending card, (4) four receiving cards with hub boards, (4) four N4 LED panels, (40) forty 3 in 1 individual LED's and (10) ten module masks.
 4. Provide LED Display processing unit with Cat5 or Cat6 twisted pair delivery. Unit to have VGA, HDMI, Display Port, SDI inputs and DVI outputs for monitoring. To have scalable inputs up or down to fit the display. To have twisted pair outputs routed to the wall and shall have DMX control. Provide with rack mount shelf and secure. Processor shall be DMX512 controlled and will require a RS232 to DMX512 converter unit. Conversion unit to be Elm Video RS232 to DMX512 converter, or approved equal.
 5. Unit to be Novastar NovaPro HD LED display controller, or approved equal. Provide all power supplies as required for a complete system. Provide all cables as required for a complete system. Also provide all LED Distribution twisted pair and power cables with transient protection as required for a complete system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furnish components, racks, wire, cabinetry, connectors, materials, parts, equipment and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and the requirements of the drawings and specifications.
- B. Installation shall follow standard broadcast wiring and installation practice, and shall meet or exceed industry standards for such work, with particular attention given to any installation instructions in Part 2 of this Section.
- C. Equipment shall be held firmly in place with proper types of mounting hardware. All equipment affixed to the building structure must be self-supporting with a safety factor of at least three. All equipment shall be installed so as to provide reasonable safety to the operator. Supply adequate ventilation for all enclosed equipment items which produce heat.

- D. Furnish the system to facilitate expansion and servicing using modular, solid-state components. All equipment shall be designed and rated for continuous operation and shall be UL listed, or manufactured to UL standards.
- E. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to insure that constant polarity is maintained. Balanced audio connectors shall be wired as follows:

Wire	Connector	Signal
Black	Pin #3 or Ring	Low or Negative
Red or White	Pin #2 or Tip	High or Positive
Bare	Pin #1 or Shield	Ground

- F. Provide all audio circuits balanced and floating, except as noted in this Section or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the inputs of the various equipment items in the system.
- G. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.
- H. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends will be accepted. Heat shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.
- I. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
- J. All solder joints and terminations shall be made with rosin-core silver solder.
- K. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature-unregulated irons shall be used on the job site.
- L. Mechanical connections shall be made using approved connectors of the correct size and type for the connection. Wire nuts will not be accepted.
- M. Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site.
- N. Label all wires in racks and console as to destination and purpose. Clearly and permanently label all jacks, controls, and connections, at the front and back of the rack, with permanent engraved laminated plastic labels or by engraving and filling mounting plates, unless otherwise noted. Attach laminated plastic labels with contact cement. Embossed or printed label tape, and press-on or lift-off lettering systems will not be accepted. All labeling shall be completed prior to final system inspection.

3.2 SOUND SYSTEMS FINAL TESTING AND EQUALIZATION

- A. The completed Sound systems shall be physically inspected by the Consultant to assure that all equipment is installed in a neat and professional manner, and in accordance with this Section. The sound reinforcement systems shall be equalized by the Consultant, BAI, Austin, Texas. Contact BAI at 512-476-3464 at least 4 weeks in advance of requested check-out dates.
- B. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site one (2) competent technicians who are familiar with the project, and who will be prepared to stay as long as their services are needed. It is estimated that approximately twenty-four (24) hours will be required for commissioning.
- C. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.
- D. Coordinate as necessary to ensure a totally quiet room during the sound reinforcement systems testing and balancing period.
- E. Prior to requesting systems testing, verify the following:
 - 1. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form.
 - 2. All specified equipment is on the job site for proper accounting.
 - 3. All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit by facsimile transmission prior to final tests.
 - 4. All equipment controls are labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control as to its function with write-on tape. Supply labels or markers suitable for indicating knob settings after equalization is performed.
 - 5. Operation manuals for every equipment item furnished are on hand at the job site.

Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing.

- F. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.
- G. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

3.3 SOUND SYSTEM PERFORMANCE

- A. After equalization and testing, the sound system shall meet or exceed the following specifications:

1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
2. Theatre: Maximum SPL with band-limited pink noise input to the system shall be 98 dB before audible distortion occurs spatial variation +/- 3dB at 4kHz, frequency response uniform to +/- 2 dB, 200 Hz to 8 kHz.

3.4 PROJECTION AND DISPLAY SYSTEMS DEMONSTRATION

- A. At a time set by the Architect, demonstrate to the Architect that the final system adjustments and tests meet the performance requirements (i.e. these specifications). All video systems and projection equipment shall be in place and adjusted prior to the demonstration of the systems. Furnish all labor, materials, tools and measurement equipment necessary for these tests and adjustments.
- B. During the demonstration work, the Contractor shall have on the job site one (1) competent technicians who are completely familiar with the operation and all details of the projection systems, and who will be prepared to stay as long as their services are needed.
- C. Demonstrate all functions of the projection and remote control systems to the Architect's satisfaction.
- D. Should such a demonstration of performance show that the Installer has not properly completed and aligned the systems, the Installer shall make all necessary corrections or adjustments and a second performance demonstration shall be arranged, at the Contractor's expense.
- E. Should a second performance demonstration fail, the Installer agrees to correct the system deficiencies under the supervision of the device manufacturer's technical staff at no extra cost to the Owner.

3.5 OWNER TRAINING AND FAMILIARIZATION

- A. The Installer shall furnish the Owner's representatives with training necessary to properly operate the systems. Demonstrate in detail all functions of the systems. Provide a minimum of eight (8) hours of instruction and familiarization for this purpose. The training phase shall be accompanied by complete as-built documentation and the custom technical systems operation manual, as described in Part 1.9. These training sessions shall be videotaped by the Installer and copies provided to the Owner with the as-built documentation.
- B. The Installer shall have a qualified representative, familiar with the system, to assist in operation at one (1) scheduled event, selected by the Owner.

END OF SECTION 27 41 00